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Random Thoughts on Innovation

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Preface

I have been blessed to have had a rich experience related to the creation, management and commercialization of innovations over thirty years. For the first twenty some years of my life I was an innovator creating exciting technology innovations. During this time I was of the firm opinion that technology innovations were the only ones that really mattered. I was involved in the late 1970s innovating products in the space of information security, electronics computer aided design and relational database management systems.

In the early 1980s I was focused on developing a good understanding of the technology invention and innovation process by pursuing a formal Ph.D. program. Some of the areas that I was attracted to were Decision Support Systems and easy use of relational data base systems. It was in the late 1980s and early 1990s I discovered my true passion – mentoring innovators, managing innovators and innovations and commercializing innovations. In the mid to late eighties I was deeply engaged in extending relational database systems to handle multimedia data. We were then developing an interesting solution named Intelligent Public Information Systems for a large telecom operator – a proof of concept prototype. My interest was soon diverted to developing interesting technologies such as Expert systems, Federated database management systems, Visual query languages image processing systems, Information security technologies, Information retrieval techniques for multimedia and intelligent systems in general.

We had created some wonderful technologies in the early 1990s. These included Video on Demand, Process and Data Migration across computers and Biometrics such as face recognition. Our group found it hard to get the world to accept and adopt our technologies, albeit they were at the cutting edge. We were living in a place that was not friendly to new technologies and solutions because the firms were not competitive enough to want to gain new markets and bigger market shares using new technologies. They had a steady stream of business and their rice bowls were not threatened. Our fortunes changed due to a progressive minded CEO of the government's agency responsible for infocomm. He opened up some

opportunities from the government sector for piloting solutions based on the new technologies. We were delighted to get this support. We pumped our heart and soul into developing outstanding solutions. The partners were happy with the solutions and we were further elated. However, they almost always ended up buying inferior solutions from established vendors. This really puzzled us. Further probing revealed to us the reasons behind their decision. And they were genuine and valid reasons. While they were pleased with our solutions based on the new technologies, they were truly concerned with the fact that these came from a research lab which had no commitment to provide maintenance and support for the solutions. This made us think very hard. Something different had to be done.

We had to bring about an organizational innovation by reengineering the organization itself!!! The late 1990s saw us redefine the mission of the organization to be user and market centric aiming to produce solutions with a 10X difference. We had to create a program that will allow promising technologies and solutions created by engineers and scientists who were passionate to see their works utilized by the world. This required transforming a quasi-academic publicly funded lab into an engine that would generate new businesses. The transformation was not easy. This was also about the time when the dot com bubble was building up. There was market pull for good talent. Venture capitalists where funding unproven and unviable ideas with irrational exuberance. We faced the danger of being hollowed out – an organization without the soul. Habits had to be changed, incentive schemes had to be restructured and relevant painful decisions had to be made. There was turbulence across the organization. Established managers felt that their power base was being eroded. Changes had to be made for the organization to survive the then challenges and march towards prosperous future.

The new organization allowed technical teams committed to creating market impact using their state of the art technologies to start companies using the concept of bridging units – units that bridged markets and the research labs. A novel scheme was created to allow a part of their project funds to be used as seed fund for starting a company. Each team had between three months to a year to develop a product, get early adopters signed up, find a meaningful management team and secure series A funding from venture

capitalists or corporate investors. This changed approach to monetizing innovations resulted in the creation of about twenty companies. Some of these companies were acquired, others perished, some are still living dead and yet others are thriving. This was a golden period. The institution was recognized by well known trade magazines such as Fortune and Forbes. Red Herring and Asian Wall Street Journal ran articles about the reenergized organization. And, I got to see first hand what worked and what did not work.

This was a second life for me. I was driven to translate and codify my experience commercializing and monetizing technological innovations into methodologies that could benefit the world at large. I could have tried to amass some wealth by becoming a consultant. Instead, I chose to join an academic organization that allowed me to both shape young minds using my experience while allowing me to engage in my new found passion – Developing a methodology for identifying promising innovations that can be used by several hundreds and thousands of innovators-to-be for making this world a better place to live in. Sharing of my experiences with students in my university was no doubt very fulfilling. At the same time I was feeling the need to get my experiences across to a larger audience and hence the motivation for this book. I hope that you as a reader will both enjoy reading this book, benefit from its contents and make this world a better place for all of us.

I thought I should add some more material in the preface before I launch into the book proper. I feel I ought to share with the readers some definitions and some prologue before I let them wander through the rest of the book. Some of the information I reproduce are things I read somewhere and I am unfortunately unable to give credit to the original authors.

Science, creativity, invention and innovation

Many minds wonder about the differences between Science, creativity, inventions and innovation. In my readings I came up with the following light hearted way of explaining the differences. I hope that you can relate to it as well.

Creativity is said to be the ability to come up with novel and interesting ideas while innovation is said to be bringing such ideas to life. Science is defined by some to be the conversion of money into knowledge and Knowledge is defined by the same as the conversion of knowledge into money. Invention is said to be the creation of a new technology or theory and Innovation is what reduces this technology into practice and makes it a commercial success.

Sustainable competitive advantage

I believe that the only sustainable competitive advantage a nation, a company or an individual could have is the ability to continuously reengineer oneself using innovations of many kinds. Innovative nations end up being leaders of the world. Innovators climb corporate ladders faster than others. Technology based innovations offer a longer life and hence revenue stream.

Is there a need for another book on innovation and why another innovation model?

This is a fair question to ask. Let us discuss different perspectives on innovations and then answer this question.

The beginning

This world is full of innovation models and methodologies. The earliest discussion relating innovation and entrepreneurship is the phrase “creative destruction” coined and promoted by Joseph Schumpeter. I reproduce the current definition of Creative Destruction from Wikipedia.

> **Creative destruction**, introduced in 1942 describes the process of transformation that accompanies radical innovation. In Schumpeter's vision of capitalism, innovative entry by entrepreneurs was the force that sustained long-term economic growth, even as it destroyed the value of established companies that enjoyed some degree of monopoly power.

Generations of innovations

Roy Rothwell recently helped define generations of innovation as follows:

Generation	Model
First and Second	The linear models – Market pull and Technology Push
Third	The coupling model - Interaction between different elements and feedback loops between them
Fourth	The parallel line model – Integration within a firm, its suppliers and demanding and active customers with emphasis on linkages and alliances
Fifth	Continuous innovation model – System integration and extensive networking, flexible and customized response.

Types of Innovations

There are many types of innovations and let us define some of them for the sake of establishing a common understanding.

Business Innovation – These are innovations for which the customers are willing to pay. Such innovations may be products, processes, platforms, components, hardware, software or services.

Fundamental innovations – These are typically innovations of a new kind. Printing press is an example of a fundamental innovation. These innovations change the way human society organizes itself in some fundamental way. Another example of a fundamental innovation is Internet.

Incremental innovations – These innovations produce evolutionary improvements that improve the performance / price ratio in a small way. A good example would be a technology innovation that improves the density of storage on disks thus driving the price per gigabyte of storage down.

Marketing innovations – There innovations find new ways of marketing existing products. The focus is often on the market

segment of interest. The example of companies in India pushing shampoos to villagers by distributing them sachets is an excellent example of marketing innovations.

Organizational innovations – These innovations change the way an organization functions on a day to day basis.

Process Innovations – These innovations normally remove inefficiencies in a process. They often reduce the cost of manufacturing a product or offering a service. They generally do not contribute to generating new revenue streams. An example of a process innovation is bank ATMs. These machines eliminated the need for human tellers. Business Process Reengineering often addresses process innovations.

Radical innovations – These are innovations that bring about a significant change in the way a product is made. For example, digital radio is a radical innovation over analog radio.

Service Innovation – These innovations improve the quality and / or efficiency of a service offering. An example is Charles Schwab's adoption of Internet even while remaining a discount brokerage firm.

Strategy innovations – These innovations change the strategy of a company or an industry.

Sustaining innovations – These are innovations are similar to incremental innovations. They improve performance / price in a small way.

Technology innovations – These are better termed inventions. Technology innovations introduce new technologies or enhance the performance / price ratio of an existing technology. Microwave is a technology innovation. Technology innovations are normally applicable to more than one product or business innovation.

Value innovations – These are innovations that focus on creating value for the customers.

Innovation Methodologies

There are some popular innovation methodologies. Let us mention some of them in the following sections.

Blue Ocean Strategy – This methodology was defined and developed by Chan Kim and Renee Mauborgne. They focus on creating value for well defined user segments. They suggest that innovators should plan to define and dominate new markets rather than focus on the competition. They have identified six paths of innovation in their earlier works and have defined a tool called Strategy Canvas and Value Curve to design innovations. The Strategy Canvas and Value curve is not unlike the Spider Web diagram that planners used to identify business goals for companies. They also identified buyer utility map, a matrix consisting of six utility levers and six stages of buyers experience cycle. Kim and Mauborgne also provided good insights into pricing based on their concept of "The price corridor of the Mass". The Buyer Utility Map, Strategy Canvas, Value Curve and conceptual pricing models were great tools for designing new innovations.

Disruptive Innovation – This methodology was proposed and promoted by Professor Clayton Christensen of the Harvard Business School. He noticed that companies with very good management were constantly losing out to newbies in their own markets. He noticed that such phenomenon was largely due to managements failing to notice new trends in the markets. Some of his famous examples are from the disk drive industry and later steel mill industry. He also identified two types of disruptive innovations – New Market Disruption and Low End Disruption. His insights were very valuable to a number of CEOs and his ideas on disruptive innovation were warmly embraced by the industry in general. Those wanting to know more about his works are directed to read his books "Innovator's Dilemma," "Innovator's Solution" and "Seeing what is next".

Technology Push and Market pull is a popular innovation methodology that was used in the early days to explain how innovations hit the market.

Innovators Vs Inventors

People often ask me the difference between inventors and innovators. Inventors are those who come up with clever ideas, processes, methodologies, models or technologies. Many inventors are most happy to create one invention after another. Innovators are those who are intent on bringing to practice inventions. They productize or commercialize good inventions. Let us take an example. An automobile was invented many times over by several famous inventors. However, it was Henry Ford who is generally acknowledged as a father of modern car. The reason is very simple. He was the one intent on producing a car acceptable to the masses at a price that was affordable. His ability to think through the assembly line required to support the mass production of cars was indeed the reason why the world adores him as the father of automobile.

Why another book on innovations

I decided to write this book for a couple or reasons. Technology Push and Market pull was a good mechanism to explain how innovations come about. There was no specific method innovators could deploy to identify innovation opportunities. Disruptive Innovation is a great step in the evolution of innovation methodologies. It would have done extremely well if it had defined a tool that could be used by innovators. Blue Ocean Strategy certainly defined a tool and a process. It could have had a greater impact if it addressed technology shift.

Besides, Disruptive Innovation and Blue Ocean Strategy are static. They cannot be extended once the framework was defined. I was always clamoring for a method that would provide extensibility. Such a method would accommodate and assimilate new thought leadership as our understanding of innovation and innovation methodologies evolved in the future.

Further, I wanted to crystallize my own experience working with twenty new start up companies by developing a new framework for spotting promising innovations with potential for success. Such an extensible method would certainly benefit companies and individual entrepreneurs alike. Hence, I wrote this up into three papers – Innovation Cube, Innovation Engine and Innovation Stack and presented it to the peers in innovation and research management community. Their inputs and ensuing refinements have actually contributed to the strengthening my own understanding and added clarity to my thoughts on how to identify innovation opportunities that promise success.

I hope that you as a reader will truly benefit from this knowledge that I am rearing to share with you.

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The heart and soul of the company is creativity and innovation.

Robert Iger

http://www.brainyquote.com/words/in/innovation178906.html

Successful Innovations

Invention, some claim is converting money into knowledge, while Innovation they say is converting knowledge into money. Science and engineering often comes up with discoveries or inventions. These are new ways of understanding nature or new ideas that would improve life on mother Earth. Innovations are defined as inventions or discoveries that are useful and are available at affordable prices. When we say “affordable price” we mean it in the context of the intended customers for the innovation. A multimillion dollar space shuttle is affordable for NASA while a multimillion dollar shoe is not affordable for a common man.

Successful innovations make money for the innovators and their companies. None of the successful innovations were created in a day. Every successful innovation was built on several failed attempts. While some innovations introduce a new category of product or service, several others simply improve the performance of current innovations on dimensions such as cost and speed. It is important for us to first understand the landscape of successful innovations before beginning the voyage of innovation simply because History is a great teacher.

Let us discuss two examples, a simple point innovation and another one that traces innovation in an industry – transportation.

Example of a point innovation

Recall seeing children’s shoes that squeak and light up when children walk. This is a very interesting innovation that people were willing pay good money for. Such innovations belong to what is generally known as Bells and Whistles. These are not foundational innovations. Footware would have been considered a foundational innovation. However, adding light and sound to a footware does not improve the original reason behind creating footware as an innovation which was to provide one’s feet with protection from forces of nature and other irritants.

Examples of a series of innovations in an industry

Let us discuss innovations in the transportation industry. These innovations can be divided into innovations for travel on land, water and in the air.

Land Transportation

The earliest mode of transportation for man must have been walking. However, walking has two disadvantages. One it is slow and second the distance covered by walking before tiring is usually short. When man found the need to travel faster then he certainly would have learnt to run. Running certainly gets a person faster to a desired destination but certainly tires the person very soon. Hence man must have been hungry for innovations in transportation. He must have tried riding some animals. Horses were probably used as a means of riding longer distances without the person becoming tired since horses were domesticated in Ukraine about 4000 BC. Initial experience with bare back riding was not comfortable. Soldiers using horses in battle found it difficult to balance riding bareback. This gave rise to the saddle as an innovation by the Samartians1 in 365 A.D. The creation of horse shoe around 770 AD improved the transportation by horse.

The transition from riding a horse to a horse cart was initiated by the Celts. Then the Romans used sprung wagons for overland journeys in the first century. Horse drawn carriages were created when there was a need to transport more than one person. A team of horses were deployed when larger groups of people were to be transported. In 1662 Blaise Pascal started the first known public transportation system using horse drawn carriages that plied regular routes, schedules and well defined fares. What an event that must have been for those who could not afford to own a horse.

Cable cars were created in 1873 to replace horses on America's streetcar lines. Cable cars had to be hauled by a long cable that moved slowly under a city's streets. The cable was spliced into a big loop. It was kept moving by a huge steam engine that had massive wheels and pulleys. The steam engine had to be located in a

[1] Samartians are said to have lived near the Black Sea

powerhouse at the side of the street. The first cable cars ran in San Francisco.

Given that the wheels on carts were invented in 3500 BC one would expect that the bicycle would have been invented soon thereafter. However, the first bicycle was created by in 1790 by Frenchmen, Comte Mede de Sivrac and it had no steering. The German Baron Karl Drais von Sauerbronn exhibited his version of a bicycle “Laufmaschine” or the “running machine” in Paris on April 6, 1818. These machines had steering but did not have pedals. A rider had to push his feet against the ground in order to move the machine. The modern version of the bicycle was invented in 1860 by Pierre and Ernest Michaux. This could certainly have been due to the time it took man to learn how to remain seated and retain the balance on a moving vehicle with two wheels. While the bicycle was a great innovation, human society still encounetered the two challenges faced by the man who used walking and running as the most primitive means of land transportation – inability to travel long distances and fatigue. Hence there was a need for a self propelled machine that would transport one or two individuals for longer distances. This resulted in the search for motorcycles. Two cylinder steam engine driven, coal powered motorcycle was the first of its kind and it was introduced by Sylvester Howard Roper in 1867. Gottlieb Daimler developed the first gas-engined motorcycle in 1885 and William Harley and his friends Arthur and Walter Davidson introduced the now famous Harley Davidson motorcycles from their company that was set up in 1903.

While the Motorcycle was a great vehicle for travel by one or two persons, there was still a need for a vehicle that can carry more. The first known automotive vehicle for road based transportation was created by Nicolas Joseph Cugnot in 1769. This was soon followed by the first steam powered road vehicle in 1801, thanks to Richard Trevithick. In 1862, Jean Lenoir successfully developed a gasoline engine based automobile. This was the precursor to our modern day car. In 1908 Henry Ford improved the assembly line for automobile manufacturing giving birth to the mass produced cars as we know of them now.

While innovators were busy developing an automobile that could carry a few people, and public transportation systems based on horse carriages, some others saw the need for a public transport system that could carry a larger number of people, a few tens or even hundreds, over long distances. This was the drive behind the creation of rail roads. Wagonways, rail roads built on wooden rails to support horse carriages or wagons existed as early as 1550 in Germany. In 1776 iron replaced wood, and in 1789 flanges were developed by William Jessup to provide better grip on the rails. Steam engine was invented by Thomas Savery in 1698. This invention was applied for several innovations including the motorcycle, early versions of car and railroads. James Watt developed the steam engine in 1769. In 1814 George Stephenson invents the first practical steam powered railroad locomotive. In September, 1825, the Stockton & Darlington Railroad Company began as the first railroad to carry both goods and passengers on regular schedules. The first train was made of six loaded coal cars and 21 passenger cars with 450 passengers and traveled over 9 miles in about one hour. Sleeping cars were introduced in 1830 for overnight travel. However the very comfortable Pullman Sleeping Car designed by George Pullman was introduced in 1857. In the early 1960s there was considerable interest in developing faster trains. This resulted in the first bullet train to be commissioned in 1964.

Water Transportation

Man used floating tree trunks to cross rivers and to fish. When he found that floating trunks were unstable he tied a few of them together to form a raft. While rafts were stable and helped man carry heavier cargo, it was certainly slow. So, man invented the primitive boat that used oars to speed up travel. Even as early as 4000 B.C. Egyptians felt the need for building large boats that could travel long waterways such as the river Nile. They built their early boats using papyrus tree. When they found the need for stronger material they used fig tree or acacia for building their boats. By 2500 to 2000 B.C. they were building 30 to 40 meter long boats with masts and sails. Oars for moving the boar were situation mid-ship while the oars for steering were placed astern.

Romans saw the need to build different types of boats for different needs – for battle, reconnaissance and ferrying troops. Large boats called Gallies were built for battles. These were an improvement over the Byzantine vessels that were used until the 18th century. A gally was about 60 meters in length and about 7 meters in width and carried about 500 men. While these ships served their purpose well, there was soon a need to build ships that could cross the Atlantic Ocean. Caravel was built between 12th and 16th centuries for such long voyages. It could carry about 70 men. Spanish built ocean going vessels capable of carrying up to 800 men when they found the need for ferrying goods and passengers to and from their colonies in America.

When man found that it was difficult to use human energy for sailing long distances, he built sailing vessels. Sailing vessels were constructed beginning the 17th century. These were typically warships that were 70 meters long and 15 meters wide and carried 120 guns and 1200 men. Sailing vessels suffered from some drawbacks. They stalled when there were no winds and they struggled in stormy weather. Man had to build all weather ships. This need for all weather ships resulted in the birth of steamship industry beginning 1803. Introduction of steamships spelled the death knell for the classical sailing ships by around 1819.

Steam driven boats were still slow. There was then a need for faster ships. The need for speed resulted in the building of motorized boats and ships in late 1800s and early 1900s. Once the desire for fast traveling all weather ships was satisfied human beings wanted to explore underwater. The desire to explore the ocean beds and to travel underwater resulted in the creation of submarines circa 1954. Wood served as a reliable building material for a long time until wood based ships suffered heavy damages from cannons during battles. The need to build ships that could survive some fire power lead to steel based battleships that appeared on the scene in early 1900s. When the aircrafts were pressed into battle, the need to use aircrafts in distant battles created the design and development of aircraft carriers starting 1919.

Air Transportation

It was the kite flying in China that started human beings to think about flying. This was around 400 BC. They used feathers and light wood to create devices for flying. Aeolipile that was developed by Hero of Alexandria and used jets of steam to create rotary motion is claimed to be essential to the history of flight. Leonardo da Vinci made the first real studies of flight in the 1480's.

Man’s curiosity for air travel started with hot air balloons. The first air travel was made by Pilatre de Rozier and Marquis d'Arlandes using a hot air balloon created in 1783 by Joseph and Jacques Montgolfier. The model flew over 3,000 feet and reached an altitude of 100 feet. Hot air balloons had open flames to hear the air and hence initiate and sustain air travel. Open flames resulted in many accidents and hence the quest for alternatives to hot air began resulting in Hydrogen balloons made in 1793. Balloons were not easy to transport and were big and clumsy. There was therefore need for alternative modes of air travel resulting in the design of gliders. Cayley invented the gliders in early 1800s and went on to show that a fixed wing aircraft that had a tail to assist the control of the aircraft and carried a system to generate power for propulsion was a good vehicle for a man to fly. Ferdinand von Zeppelin spent nearly a decade developing the dirigible. The first of many rigid dirigibles, called Zeppelins in honor of its inventor, was completed in 1900. He made the first directed flight on July 2, 1900.

Samuel Pierpoint Langley, Secretary of the Smithsonian Institute catapulted a model aircraft on May 6, 1896. This was followed by Wilbur and Orville Wright flying gliders initially in 1900. Gliders were very dependent on wind conditions and hence the race for inventing engined planes was on. The first engined plane was flown by the Wright brothers in 1903. This was the birth of modern aviation. The ability to travel long distances was proven with the first coast to coast flight took place in 1911 across the United States. The desire to take off and land planes from water saw the first sea plane contest was organized in 1912. With the successful testing of Zeppelines came the desire to establish commercial air travel. In 1910, Zeppelin provided the first commercial air service for passengers. By his death in 1917, he had built a Zeppelin fleet, some of which were used to

bomb London during World War I. Zepplines were too slow and provided an explosive a target in wartime and too fragile to withstand bad weather. They were found to be vulnerable to antiaircraft fire, and about forty were shot down over London during the war.

All this while there was the desire to develop an aircraft that would take off and land from its parked position. This desire led to the birth of helicopters. One of aviation's greatest designers, Russian born Igor Sikorsky began work on helicopters as early as 1910. By 1940, Igor Sikorsky's successful VS-300 had become the model for all modern single-rotor helicopters. He also designed and built the first military helicopter, XR-4, which he delivered to Colonel Franklin Gregory of the U.S. Army.

Once man had tasted engined air travel, he was keen to fly longer distances faster. This required newer technologies than the propeller driven plans. Dr. Hans von Ohain and Sir Frank Whittle are both recognized as being the co-inventors of the jet engine. Each worked separately and knew nothing of the other's work. Hans von Ohain is considered the designer of the first operational turbojet engine. Frank Whittle was the first to register a patent for the turbojet engine in 1930. Hans von Ohain was granted a patent for his turbojet engine in 1936. However, Hans von Ohain's jet was the first to fly in 1939. Frank Whittle's jet first flew in in 1941. The first Jumbo Jet was delivered in 1970.

Man’s quest for air travel was not limited to terrestrial flights. There was clear interest and intent to explore the space beyond our own. This required the development of rockets. The first liquid propelled rocket was developed in 1926. The race between US and USSR on trying to put a man on the moon began in the early sixties. In October 1968, NASA successfully tested the Apollo 7 and Apollo 8 missions before putting a man on the moon on July 20, 1969, with its the Apollo 11 mission. NASA persisted with space travel and the first Space Shuttle took flight on April 12, 1981.

A few things become clear as we traveled through the history of transportation related innovations. These are:

It is generally difficult for even the best of the brains to see beyond the immediate requirement. This was evident from the manner in

which ships evolved that the focus of a new innovation is always near term.

Innovations are built upon previous innovations. It is clear that every innovation was trying to improve an existing innovation along some dimension. Air travel is an example. When the gliders were functional, man started looking for engine powered air travel. The principles used in gliders were certainly carried forward in designing engine powered planes.

Several innovations may overlap at any point in time. This point has to be understood from two points of view. Let us take the example of steam engine. The steam engine was applied in more than one innovation – motor cycles, automobiles, and carriages. Also, one finds that man did not first completed his land travel based innovations before he explored innovations for sea and air travel. In fact the air travel was first explored in 1400s by Leonardo da Vinci and Cornelis Drebbel invented the first submarine - an human oared submersible in 1620. Both were long before Blaise Pascal invented the first public bus - horse-drawn, regular route, schedule, and fare system in 1662 or the creation of the first self-propelled road vehicle invented by Nicolas Joseph Cugnot in 1769.

Even disruptive innovations happen stepwise one at a time. One finds that even among land based transportation systems there was initially a horse cart, followed by a horse drawn carriage, then a steam engine based carriage that was followed by rail roads.

Further one finds that innovations do not follow a linear path. For example, there were attempts to develop sea planes even while there were attempts to develop an airworthy plane that could take off from land, or that there were attempts to develop helicopters that could land and take off from the tiniest of solid spaces.

We need to bear these examples in mind as we continue our journey on innovation education in the rest of this book.

Key take aways:

- Innovations come in two types – point innovations and series or waves of innovations
- Innovations are useful and affordable
- Innovations build on previous innovations
- Innovations focus on immediate demands
- Innovations are not linear
- Innovations can cross boundaries
- Inventions can and should be reused for purposes other than the original use.

Champions aren't made in gyms. Champions are made from something they have deep inside them - a desire, a dream, a vision. They have to have last-minute stamina, they have to be a little faster, they have to have the skill and the will. But the will must be stronger than the skill.

Muhammad Ali

http://www.brainyquote.com/quotes/quotes/m/muhammadal163972.html

Faster, Cheaper, Better

Let us study a chain of innovations in order for us to understand what is often meant my faster, better and cheaper.

One can argue that since the development of agriculture around 12,000 years ago, the two innovations that have had the most impact on our lives have been the electric light and the automobile. While the electric light eliminated the boundary between day and night, the automobile grew the geographic boundaries where we could travel and live. We will use one of these two innovations, the automobile for our discussions in this chapter.

When cars were first built, buyers were mostly interested getting from the starting place to origin. They could travel farther with less fatigue. The early cars did not have good upholstery and leaf springs and hence travel was not in comfort.

In the early 1770s, many people tried to make steam powered cars. After about a century of trying out different models, the 1880s witnessed the arrival of cars that would run well enough to use every day using steam, gasoline, or electricity. Around 1890, Europeans were driving cars made by Benz, Daimler, Panhard, while the Americans were driving cars made by Duryea, Haynes, Winton, and others. By 1905 gasoline cars became the dominant product because they were easier to use and could travel further without adding fuel. 1910s saw the size of gasoline cars become larger and engine more powerful. During this period cars also introduced folding tops to keep drivers and passengers out of the rain.

Henry Ford had a vision “to build a motor car for the great multitude which will be so low in price that no man will be unable to own one". He is quoted by many as saying “I will give you any colour of Model T as long the colour is black”. The reason behind this quote is often misunderstood. Black was chosen as the colour for model T because black paint would dry faster than other colours. Ford was focused more on improving their internal operations and his desire to deliver more cars at a faster rate than wanting to understand buyer’s likes

and dislikes. This lack of appreciate for customer's views would be a reason behind the success of other automobile companies.

Ford, Daimler and many others had aimed to produce a car that was affordable. Around late 1700s the annual wage of an average family was around 600 dollars. The car manufacturers aimed to produce cars costing around 500 dollars, which would less than a year's wages. Let us first discuss how Ford produced the different models and customers reaction to these models before understanding the impact of Ford's product innovation decisions on its competitors. The table below presents some interesting statistics about the succession of cars built by Ford until it came out with model T.

Model A started on the right note. The basic configuration was priced at 750 dollars. This was certainly fifty percent higher than the target price the manufacturers had set for themselves. Still 1750 cars were sold. Why was it? People were willing to give up riding horses and trains to buy these cars. Clearly the early buyers came from the upper middle class family. A ride on a car gave them two important advantages over travel by a horse and train. Travel by a horse was certainly less comfortable than the travel by a car. Travel by a car provided greater flexibility and more privacy than traveling by a train. Trains had fixed routes and schedules. One could travel at the time and speed to the location as determined by the rail road operators. This was convenient if one had the time and was interested in traveling to a place that was close to a rail road station. This was certainly not convenient when a person wanted to travel to a place that was far away from a car. A car ride allowed the passengers travel at their chosen speed. They could travel to any place they want as long as there was some access to that place dirt road or horse track. The ability to make as many stops as desired was also much appreciated. Also, the passengers need not follow a fixed route during their travel. They can take scenic alternative routes if they so chose.

Let us examine the innovations Model B introduced. The number of cylinders was increased from 2 to 4. It was positioned as a luxury car for touring purposes, i.e. it could travel longer distances. This required better upholstery for comfortable rides. There was no increase in horsepower. This would mean that it would travel at the same or lower speed than model A. However, the price of the car jumped three fold. Notice the number manufactured (which is the same or more than the number sold) is much less than the number of model As sold. Clearly the market was sending Ford a message. Buyers were not interested in the steep increase in price even for a luxury car that can travel longer distances.

Ford had to respond to the market feedback. This resulted in going back to the two cylinder engine. The wheel base was made longer. While a longer wheel base reduced the acceleration of the car somewhat it did introduce more stability and control. The larger wheel base also meant that model C was a larger car than the original model A. It also had more horsepower than model A, 10. The price of model C was dropped to 850 dollars. The number of cars produced was certainly more than the number of model B cars produced. This certainly was an improvement. Model C was meant to be an interim response to the market's reaction to model B. Models D and E followed in quick succession but were largely minor variations over model A and C.

Model F introduced about one year after model B and a few months after model C was the significant successor to model C. It was made as a four seater car. The wheel base was increased further to accommodate the increase in carrying capacity of the car. It also has running boards to allow easy means of alighting and boarding the car. This model sold for 1000 dollars and there were 1000 cars of model F produced.

Ford continued experimenting with a more expensive car that had 40 HP and a longer wheelbase called model K. Model K did not sell very well since it was priced almost two to three times the price of model F. This was Ford's first major experience with failure and forced Ford to think about mass producing cars that had better features and were more affordable.

Year	Model	Price	No Made	No of Cylinders	HP	Max speed	Wheel base	Features
1903[2]	A	750	1750	2	8	45	72 inches	Two eater, convertible to four seater. Rubber top cost additional US $ 35, leather version cost US$ 50. Made Ford a profit of $36,597
1904	B	2000	500	4 In-line				Luxury touring car.
1904	C	850	800	Flat 2	10		78	Larger than model A.
1905	F	1000	1000				84	Larger and more luxurious. Four seater phaeton body with running boards as standard
1906	K	2500 - 3000	900		40		114	Failed product. Was a catalyst for Ford becoming a mass producer of cheap cars
1906	N	500	7000	4 in-line	15		84	Two seater run abouts
1907	R	750	2500					Upgraded version of Model N
1908	S	700	3750					Between Model N and R. Two or three seater run abouts
1908	T		15 m					Started Mass motorization
1913	Ford produced half of all the cars produced in the US							
1927	New A – the car that succeeded the Model T							

[2] Ford motor company was started in 1903 with 12 investors and a sum of US $ 28,000

Ford had to go back to the drawing board to design model N. This car was a two seater, had smaller wheel base and was meant for local travel, otherwise known as run about and had lesser horsepower. There was certainly positive market response to this model that Ford ended up manufacturing 7000 cars. They were selling at 500 dollars. Clearly this is an example that the market rewarded Ford for producing cars that met buyers' immediate needs – cars meant for local trips and inexpensive. Ford also produced model R which was an upgraded version of model N and model S which was in between model N and model R. These were followed by the now famous model T which sold 15 million.

Now let us summarize observations relative to Ford's automobile innovations.

1. The final successful innovation was not identified the very first time. It was through trial and error and sensing the markets did Ford identify the winning innovation, model T.
2. Buyers rejected Ford's hypothesis that they would be willing to pay a premium for a car that can travel longer distances. This was the reason for failure of models B and F.
3. Buyers' clearly preferred cars designed for local travel that had correspondingly lower wheelbase and two seats.

Although Ford was very successful in building model Ts and selling several millions of them, they soon lost their product leadership in the automobile market to General motors who built cars in different colors and sizes. While the American companies were producing large cars that consumed lots of gas and were also not very reliable, the Japanese created automobile innovations that promised greater reliability and fuel efficiency.

The automobile companies did not grow organically. General Motors was built by acquiring Buick, Oldsmobile, Oakland and Cadillac. Ford Motor Co. absorbed Henry Leland's Lincoln Motor Car Co. Chrysler Corp. was built on Maxwell and Chalmers car companies and acquired the Dodge Brothers venture after their deaths. Chrysler Corp. also acquired American Motors a few years ago. So, it is important to understand that while a company may be initially set up

based on a great innovation, later growth can happen by acquiring companies that have built other innovations.

The impact of automobiles on other industry is very telling. Many highways and freeways were built in the US and elsewhere. And along those roads came up motels (motor hotels), fast-food restaurants, shopping malls, drive-in movies, drive-in banks, drive-in florists, even drive-in funeral homes. The automobile industry has spawned whole new industries where there were none before. Further, automobiles had to be distributed through a network of distributors and dealer and maintained by many automobile workshops.

Buyers often like to initially buy innovations that meet a desired function. Cars allowed people to travel longer distances in comfort in comparison to riding a horse or walking. That was a function that had to be addressed initially. Once this was satisfied, they would certainly like to buy cars that travel faster to their destination. Buyers would also expect the price of cars to reduce as automobile technology advances and matures.

Better

Buyers can understand cheaper and faster easily. But how does one interpret the word better? History of innovations in the automobile industry tells us that the cars with preferred colors, bigger sized cars, cars that had better upholstery or those that appealed to buyers' vanity were examples of what buyers considered to be better cars. Cars that were more robust and cars that were fuel efficient were also considered better. The word better is often context and industry sensitive. For example, in Japan where the streets are narrower than in the US, smaller cars might be considered to be better than larger sized cars.

Let us examine some other examples of what are the features that are considered better.

Usability

Apple has always been known for producing well designed and appealing products that are easy to use. This has been true of most of its products starting Macintoshes to iPod Videos and iPhones. Even the mighty Apple took a tumble in its design of Newton. Its eagerness to offer a more usable product using a technology that was not robust was the key reason behind the demise of Newton. Innovations that were easy to use have generally been considered to be better than those which require thick operators' manuals.

Easy to store

We have come across products designed for small houses that can be folded and tucked away. Examples are exercise machines. In some instances, even beds and tables can be folded and tucked away. You will agree that such products have been warmly endorsed by those living in small houses. Easy to store innovations have always been considered to be better than their bulky cousins.

Appealing to emotions

Incremental innovations have always impressed me when they are designed to appeal to emotions. Take for example children's sandals that light up and squeak when they walk around. These appeal to the emotions of the children wearing them while satisfying a basic function – allowing parents to keep a tab on the location of their children. Innovations appealing to emotions have always been considered to be better than those which were purely functional.

Multifunctional

Again, innovations combining two different functions have always been accepted very well by the markets. A simple example is the pencil with an eraser in its tip. For a long time we have used pencils and erasers separately. How many times have we had to get up to look for an eraser when we wanted to redo writing? Just think about it. I have done so several times myself. This simple combination that offers just enough value has always been very successful. Combining too many functions resulting in difficult to use innovations has failed miserably. Easy to use multifunctional innovations have

been considered to be better than mono-functional innovations by the market.

Experience enhancers

Many of us grew up watching black and white television for a long time. A number of us did not mind paying a higher price to buy a colour television because it enhanced our viewing pleasure. The same is true of the size of the television screens. We enthusiastically bought new television sets as manufacturers started offering larger screen sizes. Improvements in colour, screen size and resolution were considered to be better.

Companionship

Small children use toys as surrogate family when they were alone. Many of us have witnessed children talking to their toys when they are left alone with their toys. Some innovations in the toy industry have certainly addressed such needs for children. Some other innovations were positioned as companions for the elderly. An example is Aibo, the robot dog produced by SONY. It was developed as a companion to the elderly Japanese who were living alone in small apartments across the country. And it was a major hit. Companionship provided by toys of various kinds was considered better than loneliness.

Non-functional novelty

Recall Furby, the toy. It was a robot that had no special value except that it was cute and novel. It was a run away success. Buyers fought over each other to own a Furby. They found the feelings expressed by Furby toys, however limited, to be a novel feature in the toy world and hence Furby was considered to be a better toy.

Surrogate pets and toys

Tamagotchi and other virtual pets and toys have been runaway successes albeit for short runs. The reasons behind their success are very clear. Parents found them to be an easy way of introducing pets to their children. They did not have to care for such pets. There

was no need to buy pet food, bathe them, take them to the veterinarian, or find burial grounds for them when they passed away. Such pets suited them in today's busy world where both parents often had to work. Parents found virtual toys and pets to be a better means of introducing their children to a toy or a pet that did not require their attention or maintenance. Hence surrogate pets and toys were considered to be better.

We can discuss several more examples. But the above should give you a clear idea that the descriptor "better" is context sensitive

Key take aways:

1. Markets embrace innovations that create values along the better, faster and cheaper dimensions.
2. "Better" is context sensitive and can be applied in many situations.

Evolution

The act of unfolding or unrolling, hence the process of growth.

That series of changes under natural law which involves continuous progress from the homogeneous to the heterogeneous in structure, and from the single and simple to the diverse and manifold in quality or function.

http://www.brainyquote.com/words/ev/evolution162195.html

Evolution of Successful Innovations

There are at least three observed paths in which successful innovations have evolved. We will discuss each of them in this chapter.

Innovations related to the evolution of a product

Function, Robustness, safety, cost, variety, ease of use, performance

When innovations first hit the market buyers are most concerned with the functionality it offers. For example, when the first car was introduced by Ford, most of the 1750 cars made were sold. The main reason was that it served a clear requirement experienced by the society at large – the need to travel faster and in comfort. In general there is a segment of the market which can afford to buy the "value" offered by the innovation. They may not constitute the majority. We can certainly call them early adopters. These buyers may be curious, wealthy enough to invest in a new and yet unproven product and have a deep desire for the value proposition offered by the innovation. Some of them may even buy these innovative products for the snob factor. So, cost is almost always not the main concern during the first introduction of a product. Hence innovators should focus on delivering the full functionality of innovative products that bring about disruption in the market place. It is the inventors who play an important role at this stage of innovation of a product.

Once the market understands and accepts the value proposition of an innovative product, then there is a demand that the product function well. The customers would not be happy if the product breaks down often. For example, any early buyer of a car would probably have been annoyed if his car was to break down every few hundred meters. One finds that innovative products are always not robust when they are introduced to the markets. This is because of the eagerness of the company making the product to get an early

recognition from the market as the market creator and perhaps as the market leader. So, for innovators waiting for an opportunity to make a mark in the markets along with some quick bucks, they should seize the opportunity to reengineer or redesign a product that is accepted by the markets but breaks down often. It is usually the quality focussed engineers who spring into action to produce the robust products. The innovations at this stage are really incremental or sustaining in nature.

Even as innovative products become robust there also arises a concern for safety. Safety concerns manifest in many forms. In the case of automobiles safety could be realized by offering features such as good balance (preventing spills during cornering), braking efficiency and safe guarding the driver and passenger during accidents. Other examples of safety include concerns about overheating and resulting explosion of batteries in electronic devices and tamper proof medicine dispensers.

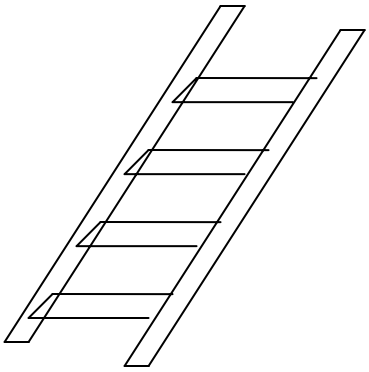
As soon as innovative products become robust, markets demand that innovators focus on offering such products at lower prices. This is often achieved by substituting expensive components with cheaper components. Hence the focus of an innovator at this stage in a product life cycle should be innovations related to cost-down engineering. This is a special breed of innovators who are constantly on the look out for lowering the cost of an innovative product. Again, this is a sustaining or incremental innovation. Lowering the cost of an innovative product will result in increasing the customer base significantly. Model T from Ford was an example of a cost down innovation that was merrily accepted by about fifteen million happy buyers.

The increased customer base then forces a different type of innovation in the markets. Buyers will often start demanding for variety. Variety includes differences in colours, shapes, sizes and other such parameters. This can be termed the era of personalization or customization. It is at this stage that the emotional demands of the customers force the direction of innovation. A classic example in the auto industry was the triumph of General Motors over Ford in product leadership after the era of model T. While Ford was busy wanting to give public the best value for their money, General

Motors under the able leadership of Alfred Sloan recognized that the market was clamouring for stylish colours, features and increased comfort. General Motors directed all its attention to mainly looks and style across all its give brands – Pontiac, Cadillac, Buick, Oldsmobile and Chevrolet.

The demand for variety is soon succeeded by the demand for ease of use. In the case of cars this demand took different forms over the history of the automobile industry. Examples include power steering, automatic transmission and reverse sensors. In the case of electronic products ease of interaction with the device was a major concern. This resulted in improvements ranging from knobs for radios to touch sensitive screens for iPods much later.

Innovations that follow ease of use related innovations are directed towards performance enhancement. Examples of performance related innovations in automobile industry are fuel efficiency and carbon mono-oxide emission standards. Although we list them in a particular order, innovations in different industries may evolve in different orders. What is important is to understand that there are innovation steps that these steps address different types of innovations at each of the steps. We call this sequence an “Innovation Ladder” or an “Innovation Chain”. We call it an Innovation L dder because each innovation is built on top of earlier innovations. We also call it an innovation chain because the innovations are tightly linked to each other. The concept of “Innovation Chain” is very powerful only because it presents a coherent image of the innovations to follow at any time. The good news is that there are pots of money in every step of the Innovation Ladder and in every link of Innovation Chain.



Innovation Chain – Product → Service Airline Industry

Such successions of successful innovations give us a hint about how to go about identifying innovation opportunities – understanding where in the wave of innovations one is currently living and focussing on the next step or chain in the Innovation Ladder or Innovation Chain. Again, it is clear that the teams required to create different type of innovations have to be different. More on that later.

Innovations related to the evolution of an industry

Standardization

It is almost always a small team of individuals who take on the challenge of creating a successful innovation that results in a new category of product or service, be it from a large or from a start up company. The initial market for a new innovative product or service tends to be small and hence the original innovators carry the burden and responsibility of producing all the components and subsystems

required to make the product. As the product becomes very popular and the market grows exponentially, the innovators find handling production of large volumes of components and subsystems a chore and a burden since their attention is focussed on developing enhancements and future versions of the product. This situation leads to dividing the product into components such that each of the components can be produced cost effectively by third party vendors. Such a development is very much in consonance with Adam Smith's observation that "labour was paramount and that a division of labour would effect a great increase in production."

Well defined standards, especially with respect to the interfaces between components are critical for the modular component level innovations to flourish. Wheels, nuts and bolts, tyres are some drivers of growth of standardized components based innovations in automotive industry. Well defined standards for interfaces between hardware and software drove the growth of innovations in integrated chips for both memory and processors in the computer industry. Again, well defined standards for interfaces between disk drives and the rest of the computer were instrumental for driving the growth of innovations in the storage industry.

It is when standards emerge that an industry is ready to grow rapidly. This is mainly because most buyers will prefer to buy from the market leaders. These buyers are also generally price sensitive. When standards emerge, components can be produced by third parties at lower costs. This is due to the fact that the business costs of smaller companies that produce such components are bound to be lower in comparison to larger companies as well as the competition amongst several smaller companies that see the opportunity to become a leader in a specific component supply market.

One can see that the arrival of well defined standards is an opportunity for component level innovations.

Innovation related to the evolution of technologies

Digital music products such as iPod are very popular these days . These products use MP3, a popular technology for digital music. What many of us may not realize is that MP3 is built upon the

successes of several technological innovations. Many of us may not realize that wireless telegraphy was the grandfather if not the great grandfather of the iPod video. Let us use the following table to understand how iPod video evolved from wireless telegraphy and other innovations.

Year	**Inventor / Innovator**	**Invention / Innovation**
1820	Hans Christian Oersted	Discovered the relationship between electricity and magnetism
1831	Michael Faraday	Discovered electro-magnetical induction
1842	Joseph Henry	Found that an electrical spark between two conductors is able to induce magnetism in needles
1858	Feddersen	Identified the oscillating character of spark-discharges
1867	James Clerk Maxwell	Developed the theory of electro-magnetism
1870	Von Bezold	Discovered interference with capacitor-discharges
1872	William Henry Ward	Filed for a US Patent for Radio development
1877	Thomas Edison	Recorded and played back human voice
1878	Oberlin Smith	Proposed wire recording
1879	David E. Hughes	Discovered that a tube of iron filings became conductive by action at distance by electrical sparks. He made a signal audible on a headphone at a distance of 500 metres
1882	Graham Bell en William H. Preece	Invented Wireless Telegraphy
1884	Calzecchi-Onesti	Designed a tube filled with iron filings, called a “coherer”
1885	Thomas A Edison	Obtained a patent for radio communications between ships
1887	Heinrich	Discovered that the effect of electrical

	Rudolph Hertz	sparks are based on a wave-phenomena in the aether
1887	Emile Berliner	Successfully recroded sound resulting in the birth of gramophone and audio records
1890	Edouard Branly	Improved properties of tubes with iron filings
1892	Preece	Transmitted signals across the Bristol Channel with his induction-system
1893	Nikola Telsa	Gave a public demonstration of radio communication
1895	Popoff	Constructed a receiver for natural electrical waves
1896	Guglielmo Marconi	Demonstrated wireless telegraphy to the English telegraph-office
1897	Guglielmo Marconi	Set up the first “Marconi-station” at Needles (Isle Wight), this station sends a signal to the English coast over 22 km
1901	Guglielmo Marconi	Syntonised (tuned) receivers and transmitters
1902	Guglielmo Marconi	Invented the magnetic detector
1903	Schlömilch	Developed the electrolytic detector
1906	Reginald Fessenden and Lee de Forest	Invented Amplitude Modulated (AM) radio
1909	Charles David Herrold	Constructed a broadcast station in San Jose
1919	Hanso Schotanus à Steringa Idzerda	Started first regular broadcasting for entertainment from his home in Hague
1919	The NRI (Nederlandse Radio Industrie/Dutch Radio Industry)	Operated a transmitter from the Hague and broadcasted a regular music program from 1919 until 1924
1920	8MK	First known news broadcast

1920s		Radio waves were used to transmit pictures for the first time. Marks the birth of television
1923	Columbia Gramophone company	Spun off Dictaphone as a separate company to sell dictation machines using wax cylinders
1930	Amateurs	Invented Frequency Modulation
1930		First successful wire recorder was introduced commercially
1945		Soundscriber allowed dictation on vinyl records. Birth of modern audio tape recorder
1947	Dictaphone	Introduced Dictabelt based on flexible vinyl belts, audio version of write once read many times technology.
1948		Very High Frequency transmission deployed in Germany
1948	Ampex	Model 200 – sells first open reel to reel audio tape machine using magnetic coating
1951	Charles Ginsberg	Exhibits first known video tape recording
1951		Minifon P55 wire recorder was introduced commercially
1954	Regency	Pocket transistor Radio powered by 22.5 volt battery was introduced commercially
1954	Ampex	Introduces first multi-track recording tapes
1954	George Eash	Developed the format for stereo 4 track cartridge at Muntz stereo
1958	RCA	Introduced Sound Tape Cartridge
1960	SONY	Markets the first transistor radio powered by a small battery
1962	Muntz Stereo	Introduced Stereo 4 track cartridges
1962	Philips	Developed standard audio cassette for saving dictations
1963		Colour television was commercially transmitted
1981	SONY	Introduced PCM F1, first truly affordable stereo recorder
1987	SONICART	Introduced DX-300 three floppy disk based

		first digital recording device
1982	Philips and Sony	Released Audio CD
1987		Digital Audio Tape released for professional markets
1989	MPEG	Motion Picture Experts Group adopted MP3 for transmitting and storing compressed high quality audio files.
1991	Alesis	ADAT machine was introduced to provide 8 track high quality better than CD recording using S-VHS format
Late 1990s		Birth of Digital broadcasting
1998	SONY	Introduced minidisc to the high end market
2001	Apple	Introduced iPod
2004	Apple	Debuted iPod mini
2004	Apple	Introduced iPod Photo
2005	Apple	Introduced iPod Video
2005	Apple	Introduced iPod Nano
2005	Apple	Introduced iPod Shuffle
2007	Apple	Introduced iPod Touch
2007	Apple	Introduced iPhone

The table gives a chronological listing of various innovations related to the modern iPod video. Although we view iPod like products as digital audio products for personal use, they may not have appeared had not Oersted had not discovered the relationship between electricity and magnetism. It then took Michael Faraday to articulate the theory of electro-magnetic induction which was used by Joseph Henry to show that magnetism can be induced in needles through creating an electrical spark between two conductors. This led the experiments on wireless communication leading to the filing of a patent for radio by William Henry Ward in 1872 that was followed by wireless telegraphy in 1882 by Graham Bell and Edison's radio communications between ships in 1885. Preece extended the range of radio communication by broadcasting signals across the Bristol Channel in 1892. This was followed by the development of synchronized receivers and transmitters by Guglielmo Marconi in

1901. In 1906 Reginald Fessenden and Lee de Forest invented the Amplitude Modulated radio that would be the plat form that Hanso Schotanus a Steringa Idzerda and others used to start broadcasting for entertainment in 1919. Dutch Radio Industry (Nederlandse Radio Industrie) was one of the early broadcasters of regular music programmes on the am radio. AM radio was succeeded by FM radio in 1930 and Digital radio in the late 1990s. SONY produced the first transistor radio in 1960. The transistorized radio and further miniaturization later resulted in portable radios, where broadcast music followed people.

Public broadcast allowed many citizens enjoy music that was until then was available only to those who could afford to buy gramophones and audio records. This in turn cultivated a following amongst citizens at large for music. Had the broadcast radio not developed then the number of people listening to music using records would have remained much smaller.

The development of radio based music broadcasting and listening was taking place even as attempts to record and play back human voice was being hotly pursued by eminent innovators such as Thomas Edison. He attempted to record an play back human voice that motivated Emile Berliner in 1887 to use Gramophone and audio recording technology to help develop private consumption of recorded music. The progress in human voice recording technology led to the development of Minifone wire recorder in 1951, Muntz stereo in 1962 and the first digital voice recording in 1981 using floppy disk storages. This was succeeded by the Audio CD in 1982. The arrival of CD Audio and SONY's minidisk in 1998 paved the way for music on the move.

In the mean time, innovators were experimenting with the transmission of pictures in the 1920s. This was the era when the television was born. It was much later in 1963 that color television was introduced.

So, we can now see that iPod video had its humble beginnings in wireless telegraphy (1820), human voice recording (1887) and television programming (1920s). It is the convergence of these three

independent innovation chains or innovation ladders that resulted in the modern iPod.

The key take away is that technologies evolve over time independently and then come together to create a value that is dear to buyers. The value iPod video offers is that music and video follows a person rather than a person being tied down a location where these are viewed. This was a major leap in value creation for digital entertainment Market.

Evolution from products to leasing services

Leasing as a service has been prevalent for many years. This is a popular form of service innovation. Leasing comes into play whenever a person or a company is either unable or unwilling to invest in the ownership of a physical object that they need. Examples of leasing range from the well known house rental services to the less obvious rental of cinemas. When houses are expensive, those with money to invest buy them for generating rental income. Those unable to invest in the purchase of a house or unwilling will instead choose to rent a house from the owners. Taxi companies are examples of leasing services. Those unable or unwilling to buy a car rent a taxi. Another example of leasing services is photocopying. Not many of us need a photocopier in our home all the time. We do not use them every hour of every day. Hence it makes ample sense to use photocopying services whenever we require copies of a document. Cinemas are great examples of leasing services. We rent the seat in a cinema hall for the duration of the movie being screened. In fact, many movie goers may not realize that a substantial portion of the price of movie ticket is for renting the seat during the screening of a movie.

So, leasing is a very important form of innovation that is service in nature. So, innovations need not simply be products. They can be services too.

Evolution from the birth of a product to its death

Let us consider a clothes washing machine for our discussions on the

life cycle of a single product. We will discuss a particular machine and not a product model. Let us then examine the nature and type of innovations that are required during the entire life cycle of a single washing machine.

Believe it or not the very first washing machine was developed in late 1600s. We will use the following table for our discussions.

Year	**Inventor / innovator**	**Description of the innovation**
BC	Babylon	Traces of soapy material found in graves dating to 2800 BC
1691		First patent for washing and wringing machine was issued in England
1782	Henry Sidgier	Was issued a patent for a rotating drum washer by the British patent office.
1797	Nathaniel Briggs	Was issued the first US patent for a clothes washer
1806	William Colgate	Started soap making in New York City
1865	William Shephard	Patents liquid soap
1879	Lever brothers	Produce Lifebuoy , a soap
1906		Mass production of electric washing machines
First world war	Germans	Used fat for washing purposes
1920s	Americans	Used soap flakes for cleaning clothes
1928		913,000 washing machines sold in the US
1932		Washing machine sales falls to 600,000 due to the great depression.
1933		Discovery of two part molecules and the creation of a detergent named Dreft. Dreft could clean lightly soiled clothes
1934		First Laundromat opens in Forthworth, Texas
1936	French	A French patent application for use of carboxymethylcellulose (CMC) as an additive

1937	Bendix	Introduced the first automatic washing machine
1943	Tide	Created a detergent made of surfactants and “builders” to clean heavily soiled clothes
1947	Bendix Delux	Introduced an improved front loading automatic washing machine
1947	General Electric	Marketed the first top loading washing machine.

The idea of a washing machine to reduce the household chores took roots in 1691. This would require good design and manufacturing. So, innovations in design and manufacturing technologies had to improve in order for the washing machine to become affordable to millions. Further, washing machines underwent several innovations as seen from the table. The early machines were washing and wringing machines. These were succeeded by semi-automatic washing machines and finally electric automatic clothes washing machine in 1937. Companies creating washing machines needed significant investments for the design, prototyping, testing, large scale manufacturing and marketing.

Although the early days of washing machine industry may have required the manufacturer to deliver a washing machine to the buyer, buyers soon wanted to compare and contrast different washing machines. This involved setting up retail outlets where the retailer could stock different type of washing machines and have the salesmen explain to the potential buyer the features of the different machines and ensure that a buyer was able to identify a machine that satisfied most of his requirement. This requires some capital investment since the retail outlet had to be rented and decorated attractively for potential buyers to step in. Again, when dealing with products from monopolistic companies the retailers may have had to deposit a minimum sum of money with the producers in order to get their machines displayed in their outlet.

Once a washing machine was produced by a company and a deal was struck with a retailer, the machines had to be delivered to all the

retailers. In the early days, the washing machine manufacturer perhaps had to handle the delivery of the machine. However, as millions of machines were manufactured and delivered it would have become very difficult for a manufacturer to deliver all its washing machines to the retailers. This led to the setting up of logistics companies that could deliver the machines to a destination at an agreed upon date and time. Logistics industry in turn produced several innovations including algorithms for optimized scheduling so that the productivity in delivery schedules could be increased. The logistics companies then grew by delivering other goods as well. Innovations in logistics industry in turn improved their ability to handle perishable goods. Setting up a logistics business requires capital for buying or leasing trucks and vans and hiring knowledgeable drivers who could deliver the machines to the retailers. It also requires know-what on the geography of the region earmarked for deliveries. The drivers need to know the location of different streets and the shortest means of getting to an address.

It is also important to note that a retailer may not wish to invest in a large outlet to store all the machines that are available for sale. He will certainly display one machine in each model and store the rest in a warehouse that is much cheaper to rent. This need for temporary storage resulted in the birth of service innovation based warehousing businesses. Setting up this business required large secured storage space that can be accessed 24 x 7 at reasonable prices. The owner of such a business could either rent such a premise from a landlord or may decide to buy the land and build the warehouse himself. Starting a warehouse business needs knowledge about market demand and capital.

Once a buyer had purchased the washing machine, he or she needed to have the machine delivered to his or her house. One option would be for the buyer to take home the machine by himself or herself. An often used option is for the buyer to have a logistics company deliver the machine to the house. This logistics company might be operated by the retailer or a preferred business partner for the retailer.

Early versions of washing machines were not robust. This is perhaps true of some of the models of washing machines even now. One can

imagine them breaking down now and then. This gave rise to the birth of washing machine maintenance industry, a service innovation. In-house mechanics had to be trained by companies for servicing the breakdown in washing machines. When the labor cost of mechanics increased, then the companies outsourced the maintenance to third party service providers. The repair and maintenance of washing and other machines gave opportunities for establishing service based businesses. Such a business did not require much capital investment and was largely based on know-how. One could get training in fixing different models of washing machines and then invest a small sum of capital to start a business.

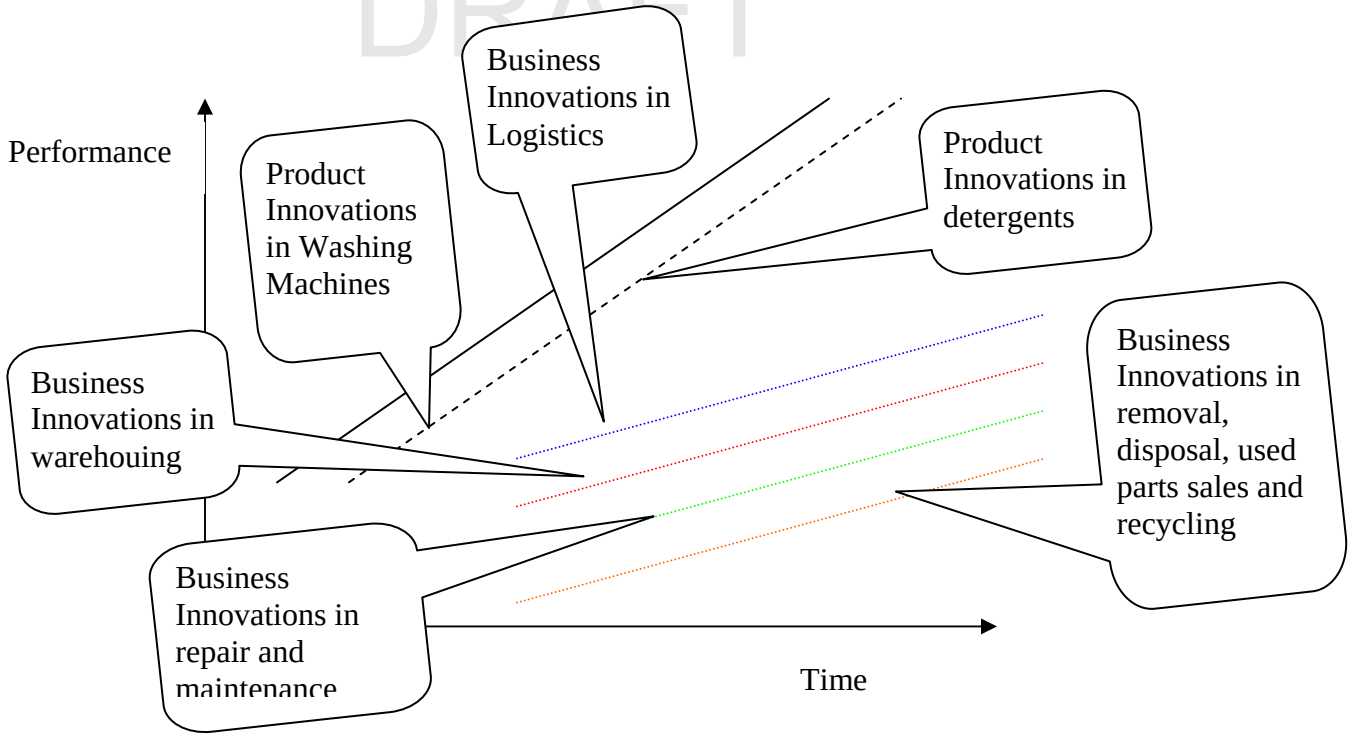
Washing machines cannot operate without detergents. Detergents had their beginnings in soap. The humble origins of soap can be traced as far back as 2800 BC to Babylon. Washing machines in early 1920s used soap flakes. This led to an opportunity for creating innovations in the detergent industry. The soap flakes were replaced by synthetic detergents very soon. This was followed by a string of innovations in synthetic detergents. This innovation opportunity gave birth to an entire industry – detergent industry. Such companies required investments in equipment, research and development, manufacturing and packaging. Of course, they could use logistics companies to ship their products to the retail outlets.

Washing machines, just like any other electrical appliance has a fixed life. A household has to engage a broken appliance removing agency when a washing machine is ready to be retired. This again gave rise to service oriented business innovations, formation of removal companies. Such a business does not require much capital. One needs to invest in a truck or a van to remove the broken machine and to deliver it to someone who would be willing to buy such a machine.

Although a washing machine might be unusable as a whole, some of it parts can be sold as spare parts for other machines of the same model that require a replacement of a part. Very few realize that the used parts sales are big time business in auto industry, for example. This also resulted in a service oriented business innovation for used parts sales. Such a business needs capital for renting space where the machine could be stripped down and useful parts recovered.

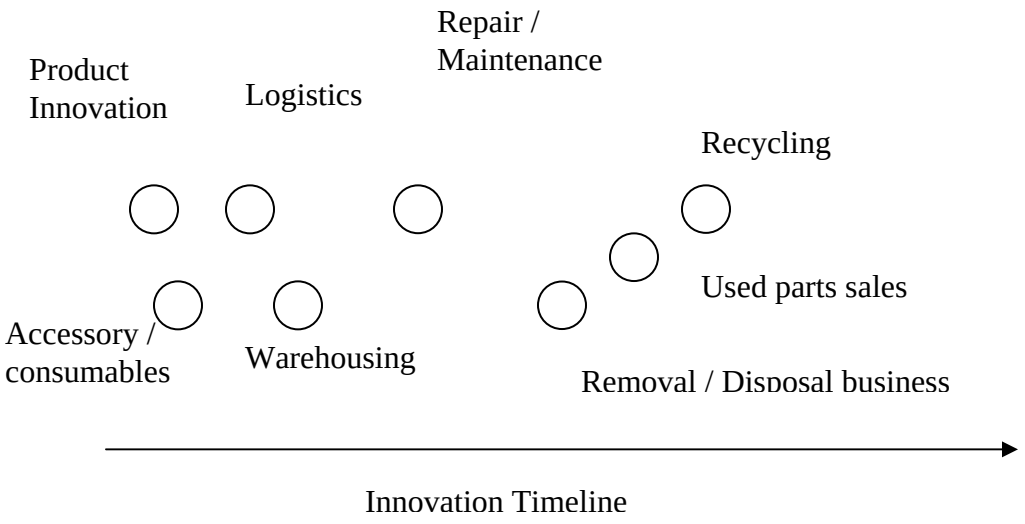
What then happens to those parts that are not useful any more? The material in the useless parts can be recovered and recycled in some instances. Such material can be sold as scrap to the original material manufacturers. This opportunity gives rise to the birth of a recycling industry that is once again service based business innovation. This industry needs capital for renting space and labor for removal of recyclable material.

We observe a few things as we stepped through the lifecycle of a single washing machine. We found that even as product innovations were continuously churned out by the manufacturers of washing machines and detergents, there were many service innovations created such as logistics, warehousing, maintenance and repair, disposal / removal, used parts sales and recycling. This is captured in the following diagram.



Usually the barriers of entry to the type of business innovations shown in the figure (logistics, warehousing, maintenance and repair, removal and disposal, used part sales and recycling) are low. As a result, these businesses will attract many competitors offering similar services. The return on investments from these business innovations will be much lower than the return on investments from product innovations. Hence, the rate of innovations in these service oriented businesses will generally be slower than the rate of innovations in the product related businesses. Moreover, all these business innovations may not kick in at the same time. Logistics will closely follow the product innovation. This is required in order for the product to be delivered to the retailer and to the buyers. Warehousing will also need to be set up around the same time, or slightly later, as the demand for the product picks up. Maintenance and repair will follow after the use of the product for a certain period of time. Removal, Disposal, used part sales and recycling will follow. The following diagram illustrates the time line of these innovations.

As the world evolved, some or all of the business innovations could have already be in place, most notably Logistics, warehousing, repair /maintenance, removal / Disposal, used parts sales and recycling. Some of these business may have to adapt to meet the requirements of the new product innovations.



We discussed several evolutionary paths for successful innovations in this chapter. Let us summarize the discussions. We find that

technical innovations do not often generate value by themselves. They need to be translated into business innovations for generating value. Secondly, we find that many products and services follow these or similar evolutionary paths. We discussed innovations in the evolution of a product, an industry, a technology and finally from its creation to destruction. At any given time one can ascertain how far along a product, industry, technology or product lifecycle innovation is along the respective paths of evolution. The opportunity for next innovation is obvious once the current state of innovation has been identified.

Take-aways:

1. When a product or service innovation is introduced it will soon be followed by a succession of innovations who collectively will define an evolution trajectory.
2. Innovation chains are useful to represent innovation evolution trajectories.
3. Innovations can evolve along multiple trajectories, sometime all at the same time.
4. Some of the evolution trajectories innovations take are:
    a. Evolution of a technology
    b. Evolution of a product
    c. Evolution of an industry
    d. Evolution of a product into a service
5. The understanding of past innovation evolution trajectories can help us in identifying the next stage of innovation at any point in time.

Many individuals are doing what they can. But real success can only come if there is a change in our societies and in our economics and in our politics.

David Attenborough

http://www.brainyquote.com/quotes/quotes/d/davidatten214811.html

Why did Innovations Succeed?

Let us understand why innovations succeed. If we understand the reasons behind success of innovations we could then perhaps develop the skills to successfully identify promising innovations. Let us pick photocopiers as an example for our discussions in this chapter.

Year	Inventor / Innovator	Invention / Innovation / Events
1906	Haloid Co	Haloid company is established to produce photographic paper and other related equipment
1937	Chester Carlson	Invented a process called electrophotography
1938		Electrophotography renamed as Xerography
		First photocopy machine was Astoria 10-22-38
1944	Chester Carlson and Battelle Memorial Institute	Chester and Battelle sign an agreement to develop a photocopier product
1948	Haloid Co	Chester Carlson builds Haloid company to commercialize Xerography. This company is later renamed as Haloid Xerox
1950	Haloid	Introduced Model A
1950	Ricoh	Kiyoshi Ichimura introduces Ricoh Flex III
1955	Haloid Xerox	The first automatic photocopying machine was produced.
1955	Ricoh	Ricoh emerges as a potential competitor for Xerox by introducing RiCopy 101 Diazo copier
1955	Ricoh	Introduced the first desk top copier
1958	Haloid Xerox	Xerox 914, the first ever commercial push button photocopy machine was produced.

		This copier produces 400 copies an hour
1962	Xerox	Haloid Xerox renamed Xerox and listed in New York Stock Exchange
1963	Xerox	Introduced the first desktop plain paper copier Xerox 813
1965	Xerox	Xerox introduced Xerox 2400 capable of making 2400 copies an hour
1970		Electrostatic printing was introduced
1973	Ricoh	Introduced the first digital fax machine
1975	Ricoh	Ricoh mounts a major challenge to Xerox by introducing the prize winning RiCopy DT 1200
1981	Ricoh	Ricoh starts selling plain paper copiers
1982		Digital printing was introduced
1983		Digital colour printing was introduced
1985	Cannon	Cannon becomes the leading photocopier company worldwide
1975-1985	Xerox	Gets side tracked by developing computers and does not pay sufficient attention to its core business - photocopiers

Photocopier machines were initially made for corporate use. The focus was on the number of copies that could be made in an hour. The table shows that Xerox improved the copying speed of its copiers from 400 copies per hour made by Xerox 914 in 1958 to 2400 copies per hour made by Xerox 2400 in 1965. These high speed copying machines were not easy to operate and often required trained operators. The machines offered a number of impressive features. Copies could be made lighter, darker, sharper or from a portion of the original.

Those who required copies of an original to be made had to fill in a copy request form and have the request signed off by his or her manager. The original and the request form then went to the central copying facility. There the trained operator made the required number of copies and retained the copy request form for his records. These

copies were then routed back to the office of request. The secretary to the manager then routed the copies to the copy requestor. Sometimes this process could take half a day or more depending on the queue for the copy requests and the assigned priority to the copy requested.

There was a good reason for this process. The copiers were expensive. The papers used for copying were also expensive. The machines were generally too complex to be operated by any employee. All these meant there was a need for a centralized operation so that a trained person can produce the copies most efficiently with least wastage. Cost of making copies was certainly a consideration.

However, all this time departments of large corporations were generally frustrated by having to wait a long time before their request for copies were met. This opened up a market for smaller copiers that had fewer features and were producing fewer copies per hour but were less expensive so that they can be bought out of the budget of the individual departments. The size of such copiers had to be small, preferably desk top. The knack of selling such copiers to address the department level demands was to understand the “pain threshold” or the budget limits within which the departments could sign off purchase orders without attracting the attention of the corporate offices. This price sensitivity was important to penetrate and dominate this new category of copiers. Ricoh understood this and hence introduced the first desk top copiers in 1955 as shown in the table.

However, the departments were very sensitive to the price of special purpose papers used in the copiers. The number of desktop copiers sold could only increase when plain paper could be used in such copiers. This certainly resulted in Xerox developing desk top plain paper copiers in 1963 called Xerox 813. It is the introduction of medium sized desk top plain paper copiers which fuelled the exponential growth of the copier market.

Once the companies understood how to make copiers work with plain paper they set their sights on the small and medium enterprises and home users. This class of users often did not require high quality and

fancy copiers. They wanted copiers that could make copies of originals with reasonable quality. This required companies to “dumb down” their products. Earlier attempts were to offer high quality copiers with very high copy resolutions. The new market did not need these features. The buyers in this market demanded “satisficing” qualities or features – features that would satisfy their daily requirements and was minimal, perhaps even “idiot-proof.” Of course the price of these copiers had to be affordable by homes and Small and Medium enterprises.

A convergence was beginning to take shape even as these developments were in play. Households and small and medium enterprises were used to having fax machines. They were not interested in investing in two machines. This forced copier companies to integrate fax and copier machines into one integrated multi-function product. An example is the Ricoh’s introduction of the world’s first digital fax machine in 1973. Of course, integrated fax and copy machines for household uses are now available for less than a few hundred dollars.

What do we learn from this example?

We find that products succeed when they address the market requirements. And the markets evolve over time. The copier market moved from corporate to department level to the small and medium enterprises and then to homes. This is not the only product that made such a journey. Computers are another example. They were initially meant to be niche products to be used by the US Defence forces. They then moved into use in the corporate headquarters as main frames, made the next step into the departments as minicomputers, reduced in size to become personal computers to be used by individuals. And they have taken the giant step of becoming even smaller as personal digital assistants and have now merged with telephones.

Key Take-aways:

1. Products are successful when they meet market requirements.
2. Products can and do migrate across different types of markets.
3. In the above examples they went from corporate to home or personal use.
4. There is no reason why they cannot migrate from consumer to the corporate use.
5. Innovators should look out for opportunities for migrating innovations successful in one market to other markets.
6. Although we have discussed migration from corporate to consumer markets, there can be other patterns of migration, for example from one industry vertical to another.

Why did Innovations Fail?

Innovations fail for a number of reasons. It is best to understand some of the reasons innovations fail so that we can avoid falling into the trap

Adoption hurdles

Some innovations are not accepted by markets because of the fear of the unknown. Genetically modified objects are one such example. The following website talks about concerns regarding genetically modified soy beans and their related products, http://www.soyinfo.com/haz/gehaz.shtml. This is an example of an adoption hurdles. Adoption hurdles may be erected for innovations due to several reasons – cultural, religious, political, social and patriotic factors.

I had an interesting discussion when we were living in Japan. It turned out that in 1984 Japan used to finger print only two types of people – foreign nationals and criminals. Hence, using finger printing for access control to buildings and facilities within a building were a taboo for general public. An advanced nation but a practice that severely stifled the adoption and hence the success of finger print based access control innovations.

We have seen many countries establish trade barriers to prevent innovations from other countries entering their own land. In the early 1970s and 1980s India was charging significant import duties for electronic equipment including computers brought into the country. This prevented the latest innovations in other countries from reaches the Indian masses in the earliest possible time. This indeed created some degree of complacency in local firms even in other sectors, automobile for example. For many years India had only a selected few models of cars produced by a few Indian companies that the public could buy. However, with the removal of such artificially erected barriers, India is beginning to see a plethora of models of automobiles reaching the markets and being available to the public at large at affordable prices.

It is therefore important to think through likely adoption hurdles before pursuing an innovation. Some adoption hurdles are low and hence can be easily scaled and hence may not pose a major problem. Other adoption hurdles are much higher and extremely difficult to overcome. Any innovation facing such high adoption hurdles is unlikely to succeed easily in the marketplace. Such innovations may require office and other means of lobbying before the markets are opened up.

Generally speaking emotionally charged adoption hurdles turn out to be more difficult to manage. Hence it is wise to walk away from an innovation that is expected to run into emotionally charged adoption hurdle, unless an organization is willing to spend considerable money and time.

Crowded market

Even the best of face recognition solutions will find it hard to gain a serious foot hold in a crowded biometrics market. Early leaders in biometrics market were companies that used finger print technology to build their identification and verification solutions. There soon followed other solution using hand contour, Iris, DNA and voice recognition technologies. So, an application wanting to embed biometrics had a number of competing technology offerings to choose from including the much taunted and poorly delivered face recognition technology. Hence it was very difficult for a new face recognition technology, however outstanding, advanced and compelling it might be, to capture the biometric market easily. The comparison will not be amongst face recognition based biometric technologies but based on the entire slew of technologies offering solutions to the biometric markets.

Demand size

Some innovations are technically or functionally exciting. However, they may not be of interest to a large enough community to be commercially viable. Such innovations while interesting will fail to capture traction in the markets.

Inappropriate Technology

Some innovations are based on what are considered to be cool technologies. The developers of such cool technology innovations try to find interesting applications for a technology. It is often a case of a technology looking for a solution.

An interesting example is the license plate recognition for parking charges at parking lots. The original technology was developed for recognizing container numbers at the Port of Singapore Authority. Shipping containers had numbers printed on them and if these numbers could be read swiftly, one could then clear containers through different check points in the port.

Once this technology was deployed successfully at the port, the creators of this technology wanted to apply the same technology to car parks to record the entry and exit times for cars and hence determine and collect appropriate parking charges. The license plates in front of passenger cars are close to the ground level. These are the plates a license plate reader in a parking lot had to read when a car entered or exited a parking lot. Heavy rains or a drive through puddles of water and mud reduced the readability of numbers on a license plate. This resulted in many operational problems in using the license plate recognition system for parking lots. The barriers in the car park would not rise to allow a car to enter since the numbers on the license plate could not be read clearly. This resulted in long queues of aggravated car drivers during peak hours. The car park attendant could do little but let them in manually. Similar incidents would happen on the exit from the car park.

Interestingly, cars in Singapore were fitted with Identification Units or IUs. Each IU had a unique identification number. A car's IU number could be read reliably by a wireless reader positioned at the entry and exit of a car park. This availability of an alternative reliable and efficient solution clearly replaced the car park operations using license plate recognition technology. This clearly proved that while number recognition worked well in one situation, i.e., the container number recognition, it was not a good solution for the car parks.

Lack of easy access to key building blocks

Innovations are built on top of pervious innovations be they products, platforms or services. Some innovations require the use of building blocks also known as complementary assets. For example, if an innovation requires some form of electronics and if this electronics is closely held by a company and if that company is unwilling to license the required technology at a reasonable prize then the chances of the new innovation reaching the market place is all but slim. So, every innovator has to consider the easy availability of all the building blocks required for the innovation before setting out to build the innovation.

Me-Too innovations

Some innovations are marginally incremental in value creation and try to take on established market leaders. It is often futile to try and enter a market after it has identified a market leader. A good example of this is the number of e-commerce sites that were launched once Amazon was successful in creating a significant membership. While many of such imitators failed and some still survive none have grown to be as successful as Amazon.

Mismatched markets

Let us still continue face recognition technology for our discussion. Often times, biometrics is but a small part of a larger solution sought by a government organization or a private company. Hence, a company offering a new and effective biometric solution is very much at the mercy of the prime contractors of the project. The problem becomes more acute if there are a large number of suitors for the project. Very rarely do all of the competing offers use the same component biometric technology. Hence, even a great biometric solution might be overlooked not because it is not good but primarily because the major contractor bidding for the project did not offer compelling value proposition to the government organization or the private company.

Biometrics as a start up company needs to realize that the selling cycle to government organization is long and arduous. This

positioning demands that the company have enough cash flow to last until detailed comparisons are made and the winners are announced. Start up companies that are primarily focused on government tenders for their initial success and without sufficient funds for a long haul benchmarking and selection game are bound to fail independent of the quality of the innovation.

Market readiness

Some times innovations are released into the market well before the markets are ready to accept and adopt them. Examples abound. Monsanto is a well know example of introducing genetically modified products before the markets were ready for it. Monsanto invested in genetically engineered agricultural products for several reasons such as increasing the crop productivity, reducing the vulnerability to attacks by insects and robust yield across all kinds of weathers. However, the public at large were not sure about the after effects of consuming genetically modified objects. They feared that consuming such genetically modified crops might turn them into Frankensteins some time in the future. The reception to genetically modified objects might have been warmer if Monsanto shared with public the information from their experiments with such food on human beings. Such shared information could result in increased confidence in the consumption of genetically modified objects.

Perception of lack of ethics

Monsanto states it is an agricultural company that applies innovation and technology to help farmers around the world produce healthier foods, better animal feeds and to reduce the agricultural impact on our environement (www.monsanto.com).

Monsanto recently filed for a patent with regard to genetically engineered pigs. The innovation was to breed pigs that can be engineered to grow fast and produce more pork per pound of feed.

The following is an extract from the following website http://www.greenpeace.org/international/news/monsanto-pig-patent-111

> “But again, Monsanto wants to own not just the selection and breeding method, not just the information about the genetic indicators, but, if you pardon the expression, the whole hog.
>
> - Claim 16 asks for a patent on: "A **pig offspring** produced by a method ..."
> - Claim 17 asks for a patent on: "A **pig herd** having an increased frequency of a specific ...gene..."
> - Claim 23 asks for a patent on: "A **pig population** produced by the method..."
> - Claim 30 asks for a patent on: "A **swine herd** produced by a method..."
>
> This means the pigs, their offspring, and the use of the genetic information for breeding will be entirely owned by Monsanto, Inc. and any replication or infringement of their patent by man or beast will mean royalties or jail for the offending swine.”

Pig farmers and pig feed farmers were generally worried that such pigs will be fed with “**Monsanto Brand** genetically engineered feed grown from **Monsanto Brand** genetically engineered seed raised in fields sprayed with **Monsanto Brand** Roundup Ready herbicide and doused with **Monsanto Brand** pesticides”. There is the concern that Monsanto is planning to occupy the whole value chain.

Business ethics blog http://www.businessethics.ca/blog/2006/05/monsanto-argentina-and-trade-in-gm.html talks about the public perception of Monsanto as a company. The Ethical investing website http://www.ethicalinvesting.com/monsanto/ also lists Monsanto’s investments they consider to be unethical. Many innovations coming of out a company attract animosity and negative publicity when the public perceive the business ethics of the company.

Hence it is important to ask oneself whether a particular innovation or the company through which the innovation reaches the market is considered to be ethical. Even a great innovation distributed through “unethical” channels is likely to be a failure.

Pricing

Sometimes innovations are priced either too low or too high. The pricing of the innovation depends on the market segment it addresses. The more exclusive the market segment, the volumes could be small and hence the pricing has to be higher than those targeted for the masses. Pricing has to reflect the value offered by the innovations. If the value created is high then the markets will be willing to pay a higher price. If the value created is low then the innovation has to be priced lower. Some have experimented with pricing high value creating innovations either low or at reasonable prices. Buyers have been circumspect about the claim on the value created when such innovations are priced low. Hence, the pricing of an innovation has to truly reflect the value created.

Proprietary solutions

Innovations built using proprietary solutions succeed when they address niche markets. As innovations evolve those offering proprietary solutions are often left behind. A good example is Apple's Macintosh. Mac was always a great machine to use. Apple had many interesting proprietary features built into their computer. It was reluctant to open up the insides of Apple Macintosh to third parties so that they can develop subsystems and add-ons. This resulted in Apple's inability to dominate the personal computer market.

Contrast this to IBM's personal computer. Once IBM realized that they were on to a major trend, they modularized the personal computer and built an ecosystem of developers for their personal computers. This included disk drive manufacturers, memory chip manufacturers and third party software developers. Such openness created an opportunity for smaller players to address the different components of the modularized personal computer more efficiently than IBM itself and lead to the creation of the personal computer industry. We can argue that IBM might have not grown its personal computer business to the same size if it had not followed modularization of its personal computer.

You could ask why Microsoft succeeded in dominating the operating system and office applications market. It is easy to see that operating

system was a component of a personal computer and there was no credible competition for Microsoft. Even though Microsoft is seen to be successful one might ask whether the domination of the operating systems market by Microsoft might have stunted the growth of the product. The evolution of the operating system and accompanying software might have grown to even dizzying heights if Microsoft had modularized and opened up their operating system. Third part vendors could have certainly contributed rich enhancements to the different parts of an operating system.

Microsoft started small with its proprietary operating system QDOS. There were alternative offerings such as CPM from Digital Research. However, it was the clever marketing and sales strategy that allowed Microsoft to dominate the operating system market initially. When we examine the evolution of office software, the initial product offerings came from Lotus Corporation and WordStar and Word Perfect from other vendors. It was the competition's inability to keep lock step with the evolution of operating systems that created an opportunity for Microsoft to replace the original solutions with their own. In other words, lack of strong competition at component level resulted in the vertical integration achieved by Microsoft.

Some of the proprietary innovations that did not achieve market leadership range from Betamax from SONY to IRIDIUM by Motorola.

Regulations

Regulations are often put in place for safeguarding the interests of the public at large. It is therefore important to ensure that innovations satisfy the regulations in the markets of interest. There are many industries that require innovations to comply with regulations. Examples are the FDA's and equivalent regulations for the healthcare sector, FAA's and equivalent regulations for the aviation sector, and FCC's and equivalent regulations in the telecommunications sector.

While regulations are often put in place by government agencies, there are also industry standards that also act as some form of regulations. Innovations that intersect with industry standards need to meet the requirements set by the respective professional and industrial bodies.

Scaling

An innovation is usually widely adopted only after it has been accepted by a critical number of buyers. It is difficult to push an innovation to be accepted by the markets if the value created by the innovation is either low or not obvious. Buyers trust market leaders. Hence, innovators have to focus on achieving market leadership once their innovations attract a steady stream of buyers.

Tainted market

Let us study the experiences of a company called XID technologies. XID technologies created a radical approach to identifying face recognition. Their face recognition technology was far superior to alternatives. They found selling good reliable solutions based on their vastly superior technology was not easy. This was mainly because several vendors had already released face recognition based biometric solutions that did not work well. The market's initial exuberance was dampened by their experience with the poor solutions offered by these early entrants into the market.

It is therefore important to pick a market that has not been tainted by unkempt promised or poor solutions. It takes a lot more effort to win back the confidence of a frustrated customer than enter a new market which is still unspoilt.

Technology ahead of its time

Sometimes one creates a technology or business innovation ahead of its time. Such innovations fail not because they are inherently unworthy, but because the markets may not be ready for it. CommonTown was a company founded in late 1990s. It would allow users to buy virtual land in Cyberspace, not unlike Second Life. However, the solution came out when there was not a large enough adoption of Internet across the world. Second Life bears some similarities to CommonTown and is now wildly successful, perhaps because of the current levels of adoption of Internet and the familiarity of the users to social networks. So, technology or solutions that are created ahead of their time are generally not successful. A

good example of this was the Apple's Personal Digital Assistant (PDA), Newton. The main selling point of Newton was its hand writing recognition as an alternative user interface. However, the technology used was not robust enough for Newton to be successful.

Timing and patent

Sometimes markets may not need an innovation. A classic example is the touch screen. When Don ??? filed a patent for touch screen while he was working for the Xerox Palo Alto Research Center. This is an innovation a number of us use today. However, the market did not have an immediate demand for this innovation at that time. Interestingly enough the commercial success of the innovation started once the patent protection for the innovation expired. Hence it is important to understand the market demands and the best time to file for patents. Sometimes it makes perfect sense to file for a patent once the demand for an innovation is clear.

Wrong application

Third Voice was a Singapore company that was founded in the United States in the late 1990s. They came up with a clever technology – an electronic post-it note. This was the time when everyone was creating electronic equivalents of every physical item they came across. Third Voice wanted to give customers an opportunity to express their experiences with the products and services of different companies. TV as they came to be know found a means of letting customers write their comments about their shopping or product experience and post it to the website of the respective company. One could go to TV and type WWW.SONY.COM and the site took the customers to the SONY's website, unaltered, superimposed with comments from their customers.

One would think this type of service would be a great opportunity for companies to get to know their customers' reactions to their products and services. Ah, Ah, not to be. The problem was that most of the postings were brickbats and not praises. This actually riled the companies' public relations and corporate communications offices. About 400 websites and companies rose up in arms and created a website called www.saynotothirdvoice.com. Many of them raised felt

that Third Voice had violated the copyright of their websites by allowing individual customers to post their views. They felt that Third Voice was encouraging web graffiti. A number of the companies sought legal counsel to explore suing Third Voice for damages. Some even approached the US Attorney General's office for their intervention. However, no serious legal action followed.

Let us examine why Third Voice failed. Third Voice's interest in setting up the browser with a e-post it note for customer comments was done in the spirit of "free speech". Their original intention was to develop a cool technology. There was no clear analysis on the likely reactions from those affected. Also, there was no clear business, revenue and profit models.

How could Third Voice have turned their technology into profits? Third Voice could have positioned their website as a customer feedback channel for companies. Customers could post their experiences with the products and services offered by the different companies and companies could have been given access to view the content of the postings relevant to them. Many companies would have welcomed such a feedback. It would have been akin to the mystery shopping exercise deployed by several companies.

That e-post it notes have gone to be used in other profitable scenarios is history. It remains that Third Voice had a winning technology but a poorly positioned product.

Wrong marketing channels

The story of Pet.com and Webvan.com are interesting to study. Pet.com wanted to be a one stop shop for all pet related shopping. However, it is clear that people who really love their pets would like to shop in person rather than over the net. Webvan was founded by the successful founder of Borders bookstore. WebVan was supposed to deliver groceries to those who ordered them on line. However, the company did not think through the fulfilment aspect thoroughly before they launched the service. As a result the company did not attract many customers. Internet cannot be seen to be a panacea for all marketing problems. Products that are bought based on touch and feel and with tender loving care certainly are best offered through

brick and mortar channels. So, innovations that are offered through wrong marketing channels are unlikely to succeed.

Key Take-aways

1. There are a number of reasons why innovations can fail
2. Some of the reasons are well within the control of innovative individuals or ente3prises and hence can be managed.
3. Some others reasons for failure of innovations are beyond the control of the innovators and hence are best avoided.

It is important to assess potential adoption hurdles before one starts developing an innovation.

“A dream with courage is innovation...A dream without courage is a delusion”

- An unknown source

-

Innovation Cube – the innovation framework

Albert Einstein is quoted as saying that “Innovation is not the product of logical thought, although the result is tied to logical structure.”

(http://thinkexist.com/quotes/albert_einstein/)

I would have blindly believed it had I not been a part of a team that helped build about twenty companies. When you work with the founders with big dreams and even bigger egos you start learning why certain approaches worked while the rest did not. It is from this experience one can glean some logical approaches. And one nice means of thinking logically is to define a framework that can be the basis for making innovation and innovation a little more logical than it presently is.

My wife was always fascinated by the rapid adoption of the mobile phone. I was raking my brain the reasons for such rapid adoption. Let me replay the world as it existed prior to the widespread adoption of the mobile phone.

It all started with the cordless phones at home. How convenient were they? One could hold a conversation anywhere in the house – living room, kitchen, bathroom, bedroom or even a veranda if there was one. It liberated the human society from being bound to a location where the phone can be used.

Pre-mobile phone era was a night mare for many of us. I had to first locate a pay phone when I was outside of my home and had to make a phone call, however short the conversation was going to be. The pay phone was usually located where there was most traffic – shopping centres and food courts. Once I found a pay phone there would be a long queue of anxious people standing in a line waiting for their turn. I had to join the tail of the queue praying that the line would somehow disappear fast. And at the same time, the person using the phone would be talking for a very long time seemingly oblivious of the long snake of people waiting for their turn to use the same phone. Well, self-interest comes before social consciousness for most of us. I used to either leave the queue in frustration or wait suffering from

mental agitation on why the speakers ahead of me could not be more considerate and keep their conversations short.

When I finally got to the phone, if I ever did after what appeared to be an eon, it would turn out that the phone only accepted a card and not coins – and I may not have a card on me. And if it did accept coins, I found that sometimes there were not enough coins on me when I needed them most. It was not surprising because no one enjoys walking around with pockets full of coins jingling away. So the experience of a making a phone call from a pay phone was not always exactly a breeze. There certainly was pain and deep pain suffered by a large section of the society.

Little wonder then that when mobile phones came into being and when they were small enough to carry all hell broke loose. The sales of mobile phones skyrocketed, especially in countries where the landlines were either inadequate in numbers or offered poor voice quality.

Pain defines need. Severe pain defines significant need. Severe pain suffered by a very large community defines a golden opportunity for innovation. If necessity is said to be the mother of invention, severe pain suffered by a large community can be said to be the father of innovation. Need is something that we cannot live without. We are social animals who enjoy communicating with each other. Communication is a need for the human society. There should be no surprise that human society's need for convenient communication was met totally by the mobile phone. And that is the secret behind its runaway success.

So, we are ready to define the first axiom of Innovation.

Innovation Axiom 1: Innovate to fulfil a need

A corollary of the Innovation Axiom 1 is: Innovations that fulfil a significant need of a large community succeed.

This actually set me thinking. Surely not all commercial successes have been need based. Furby was not need based. Was it? How about colour television? Was it need based? What need does a

roller coaster fulfil? These successful innovations made me think that there should be another reason behind the success of these innovations that were truly not need based.

It then dawned on me that this category of innovations was different and that they were not fulfilling a significant need. Perhaps they were addressing demand for enhanced experience.

To be continued